ORIGINAL

SCIENTIFIC_GENERICS

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EX PARTE OR LATE FILED

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24 April 1995

Mr Donald Gips
Deputy Chief
Office of Plans & Policy
Federal Communications Commission
1919 M Street NW
Washington DC 20554

RECEIVED

APR 25 1995

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

Dear Mr Gips

Re: Ex-Parte Presentation CC Docket no: 92-297 ET Docket no: 94-124

On March 16, 1995, during our meeting concerning the availability and quality of equipment for the local multipoint distribution ("LMDS") operating in the 40.5 -42.5 GHz ("41 GHz") band, you asked that I supplement the record by providing additional technical and economic information on the 41 GHz LMDS equipment, and a summary of the status of the authorisation and deployment of LMDS services in other portions of the world. Please find attached the information that you have requested.

Should you have any further questions, please feel free to contact me.

Yours Sincerely

Teddy O'Connell

Dr Teddy O'Connell

No. of Copies rec'd 0+2
List A B C D E

1. The State of the Art of 41 GHz LMDS Technology

A. Analogue LMDS Equipment

The UK is the current leader in developing 41 GHz MVDS equipment. In 1990, the United Kingdom's Radiocommunications Agency convened an ad hoc group, the 40 GHz MVDS Working Group, to assist in formulating broad plans for the use of a form of LMDS, called microwave video distribution service ("MVDS")[1].

Based on specifications developed by the 40 GHz MVDS Working Group, demonstration analogue 41 GHz MVDS equipment has been designed and manufactured by Philips Microwave. They will initiate production of this equipment in quantities adequate for distribution to subscribers in mid-1995. GEC Marconi are also developing a demonstration system and this will be available in a matter of weeks. See letters from GEC Marconi to Scientific Generics, dated 28th February 1995 and 12th february 1995 (attached hereto as Appendix B). Components for 41 GHz MVDS also are available from a number of other suppliers such as Dudley Labs, Farran Technology of Ireland[2], Thompson CSF and RACAL.[3]

The current Philips Microwave analogue 41 GHz MVDS receiver unit is based on direct broadcast satellite ("DBS") downconverters and employs an extra downconversion stage. Essentially it consists of a small, low-cost horn antenna with a high gain (32 dBi) which eliminates the need for an LNA in the receiver. The antenna is connected to the first stage of the receiver which downconverts the 41 GHz signal to a first IF (Intermediate Frequency) of about 12 GHz. The second stage is a standard DBS downconverter which converts from 12 GHz to an IF frequency of 950-2000 MHz. The second IF is fed directly into a standard commercially available DBS set-top box.

The existing analogue 41 GHz MVDS transmitter unit consists of four modules each with eight separate transmitters, plus one redundant transmitter which is on hot standby. A separate transmitter is employed for each channel. The PA technology employed uses MMIC GaAs pHEMT power devices of 23 dBm per channel. By 1996, transmitter powers of 1 W per channel are projected to be available.

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[1] A list of participants in the UK's current 40 GHz MVDS Working Group is attached as appendix A.

[2] See Letter from Farran Technology to Scientific Generics, dated 10th April 1995. (Attached hereto as Appendix C).

[3] Both Hughes and Siemens are manufacturing 44 GHz TWTAs with power outputs of 200 watts. Therefore, production of 41 GHz band components should be easy to accomplish.

The analogue 41 GHz MVDS system utilises 64° sector coverage antennas (such as a sector horn), with a gain of about 15 dBi. Under conditions of maximum rain attenuation, this type of antenna provides a roughly circular coverage with the transmitter on the circumference. Although four 64° sector coverage antennas are required in each cell, sector antennas provide MVDS operators with greater architectural flexibility than omni-directional antennas. For example, sector antennas permit the operator flexibility in choosing the transmitter location and utilising spectrum more efficiently because of their higher gain and ability for greater spectrum reuse in urban areas.

As a member of the 41 GHz MVDS Working Group, I was invited to review Philips Microwave's 41 GHz MVDS demonstration equipment, consisting of a video server, 41 GHz analogue transmitting radio equipment and a standard DBS receiver set-top-box. The front end 41 GHz MVDS receiver has a 60 dB attenuation pad in front of the antenna to stimulate path loss. The line-of-sight path between the transmitter and receiver was approximately 100 meters. During the demonstration, Philips Microwave placed two television sets side-by-side; one was connected to the video server and the other was connected to the receiver signal. I was not able to distinguish between the picture quality of either signal. If you are interested in observing a working demonstration of either the Philips Microwave or GEC Marconi 41 GHz MVDS system in Washington D.C., please let me know.[4]

B. Digital LMDS Equipment

In 1994, the United Kingdom Radiocommunications Agency reconvened the 40 GHz Digital MVDS Working Group to develop specifications for digital 41 GHz MVDS with voice and data return links. Specifications for a digital MVDS system are being developed in order to provide greater spectral utilisation, better or more stable picture quality, greater interactive capability (e.g. Video-on-Demand), and more efficient cell re-use than analogue 41 GHz MVDS. The proposed digital 41 GHz MVDS design is likely to be compatible with DBS systems, and will employ MPEG-2 compression techniques, QPSK modulation and 39 MHz channel spacing. The letter from GEC Marconi to Scientific Generics dated 12th April 1995 (Attached hereto as Appendix B), confirms that it are developing a digital system based on these criteria and my understanding is that Philips Microwave is doing likewise. A recent submission from the RA to the MVDS working group suggests one possible digital MVDS channel plan based on the digital ASTRA channel plan. See letter from the RA titled "Possible

[4]Both GEC Marconi and Philips Microwave have indicated their willingness to demonstrate this equipment. See letter from GEC Marconi to Scientific Generics, dated 12th April 1995, and letter from Philips Microwave to Scientific Generics, dated 24th April 1995. (Attached hereto as Appendix B and Apendix D).

MVDS Channel Plans", dated 20th April 1995 (Attached hereto as Appendix E). This indicates that a channel spacing of 39 MHz could provide 96 channels (of approx 34 Mbits per second) plus 4 return channels, in the 2 GHz available. Given that MPEG-2 compression results in data rates of between 2MBit/s and 6MBit/s for typical entertainment channels, this will provide the capability for a minimum of 480 programming channels in the 2 GHz bandwidth. Philips Microwave is presently developing a digital 41 GHz MVDS demonstration system and plans to have this available by late 1995. Philips Microwave expects to begin manufacturing digital MVDS equipment in late 1996. See letter from Philips Microwave to Scientific Generics, dated 24th April 1995. (Attached hereto as Appendix D). As indicated by their letter to Scientific Generics, dated 12th April 1995 (Attached hereto as Appendix B), GEC Marconi expect to have a 40 GHz digital MVDS demonstration system available by June 1995.

2. Cost Estimate for 41 GHz MVDS Equipment

Based on a recent submission to the RA MVDS Working Group[5], the initial cost of a 32 channel (plus 4 on Hot Standby) transmitter unit has been estimated at between £33,000 (approx $49,000) and £57,000 (approx $85,000). This system as described above employs a cost penalty (due to PA "Hot Standby") of 4/32 = 12.5%, which compares very favourably with the cost penalty of 100% when using a TWTA PA. This is made possible by the provision of a separate MMIC PA for each transmit channel.

In the same report the initial cost of the Receiver front end unit (including antenna, 2 stage downconverter and excluding indoor set-top box) has been conservatively put at between £65 (approx $97) and £130 (approx $195). As the market for 40GHz components further matures it is likely that this will significantly decrease.

3. The Status Outside the United States of Authorisation and Deployment of LMDS at the 41 GHz and the 28 GHz Bands

In 1990, the 40 countries that comprise the Conference on European Posts and Telecommunications ("CEPT") adopted a recommendation that the 41 GHz band should be allocated domestically to MVDS services. Of these 40 countries, 11 have already implemented the recommendation and have allocated the 41 GHz band for LMDS-type services and 9 countries plan to do so. These countries include: Austria, Croatia, Czech Republic, Denmark, Finland, Germany, Greece, Hungary, Northern

[5] "Microwave Video Distribution Systems - The 1994 Position", Ian Clarke, Philips Microwave, 7th december 1994..

Ireland, Italy, Liechtenstein, Netherlands, Norway, Poland, Portugal, Sweden, Switzerland, Turkey and the United Kingdom. To date, the United Kingdom has been the most active in deploying 41 GHz MVDS services.

The United Kingdom permits the deployment of MVDS systems pursuant to a local delivery service ("LDS") franchise awarded through a competitive bidding process by the Independent Television Commission ("ITC") under the Broadcasting Act of 1990.[6] LDS franchises must serve more than 1,000 homes and deliver television and radio channels over a cable television system and/or a 41 GHz MVDS system. In the United Kingdom, MVDS can extend TV service to areas where it is uneconomical for wire-based cable television systems to provide service. In addition, MVDS can be utilised to provide 2 way interactive TV service.

The franchising process in the United Kingdom for LDS is summarised below:

a) The ITC advertises a franchise area in which a potential applicant has expressed in interest to provide LDS service and invites applications, specifying the frequencies that would be available for MVDS, the closing date for the receipt of applications, the application fee, and the minimum price a successful applicant would be required to pay.

b) applications are submitted which specify the amount of the cash bid for the franchise.

c) The ITC publishes the names of certain information on the applicants.

d) The ITC will award the franchise to the highest bidder provided that:

  i) the bidder meets the ITC's "character" qualifications;

  ii) the proposed telecommunications system is acceptable to the telecommunications licensing authorities, and if appropriate, the wireless telegraphy licensing authorities

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[6] The award of an LDS franchise involves the issuance of two to three different licenses, including:

a) a local delivery service license granted by the ITC under the Broadcasting Act of 1990
b a license for operating a telecommunications system issued by the Department of Trade and Industry under the telecommunications act of 1984, and

c) if the service includes the use of MVDS, a license by the Radiocommunications Agency under the Wireless Telegraphy Act of 1949.

iii) the ITC is satisfied that the applicant is financially able to maintain service throughout the period of the franchise.

iv) the source of funds for the venture is not contrary to the grant of the public interest, and

e) exceptional circumstances may be used to award the franchise to an applicant other than the highest bidder. Exceptional circumstances relate to the extent of coverage of the franchise area which any applicant may propose if it is substantially greater than the area proposed by others.

The ITC document is attached in Appendix F. An LDS franchise runs for 15 years from the date when service under the license is started, and franchises have a high level of renewal expectancy. See ITC Document "Local delivery Services - A Guide for Franchise applicants". (Attached hereto as Appendix F).

In 1993, the ITC authorised Eurobell to build and operate and LDS system to provide both 41 GHz MVDS and cable television services in West Kent, England, in an area comprised of approximately 97,000 homes and 2,000 businesses. My understanding is that Eurobell is in the process of setting up a number of operational cells. The 41 GHz MVDS equipment is based on the field trial system which Philips currently has in operation in Croyden, England. The UK managing director, Mike Stewart has described this MVDS Demonstration system in his letter to Scientific Generics, dated 24th April (Attached hereto as Appendix D). Eurobell's commercial 41 GHz MVDS and cable system will be operational by 1996. The system will use both analogue and digital technology and will consist of approximately 35 cells, with an average of 1,500 homes per cell. Of the 97,000 homes in the West Kent service area, 57,000 homes will be served by a wired cable delivery system, 16,100 homes will be served by a 60 channel 41 GHz MVDS delivery system with a wireline backbone ("regional relay"), and 16,500 homes will be served by a 40 channel 41 GHz MVDS delivery system ("local relay"). See Table A, Eurobell Proposed Services. Eurobell paid £15,000 (approx $22,000) for its franchise and its LDS system will cost approximately 61 million pounds (approx 91 million dollars) to construct.

SERVICE	CABLE	MVDS regional relay	MVDS Local Relay
TV - 40+ channels	Y	Y	Y
Interactive TV	Y	N	N
Interactive TV via BT line	Y	Y	Y
PC video conf.	Y	N	N
PC video conf. via BT line	Y	Y	Y
Voice/Fax mail boxes	Y	N	N
Voice/Fax mail boxes via BT line	Y	Y	Y

* Eurobell also is considering offering interactive services employing the Digital European Cordless Telecommunications Standard.

TABLE A: EUROBELL PROPOSED SERVICE

The ITC also has recently solicited bids for other LDS franchises including for the Midlands, England and the Northern Ireland franchise areas. See ITC Press Releases (attached hereto as Appendix G). Applicants for the Midlands include three subsidiaries of Fundy Cable Communications Ltd.: Tamworth Cable Communications Ltd.: Burton Upon Trent Cable Communications Inc.: and Hinckley Cable Communications Ltd. These three companies all initially propose a 40 channel wire-based television and telephone service. However, they have indicated that they will utilize digital 41 GHz MVDS technology in order to extend to non-urban areas their initial service offering for their LDS system and to include additional homes within their franchise area.

There are two applicants for the Northern Ireland LDS franchise. The first is NITEL Ltd., a joint venture between CMI Ltd. and Matav-Cable Systems Media Ltd. CMI Ltd. has a close relationship with Philips Microwave and currently is involved in a research consortium seeking project funding from the Commission of the European Union to test 41 GHz MVDS. NITEL Ltd. proposes to deploy a LDS system consisting of cable television and digital 41 GHz MVDS to 98,700 homes and 371,000 homes respectively. See Table B, NITEL Ltd. Roll Out Plans. The digital 41 GHz MVDS portion of the system will utilize 4 kilometre cells and QPSK modulation.

Year	96	97	98	99	2000	2001	2002	2003	2004	2005	2006
MVDS	0	0	0	0	0	0	0	18K	27K	27K	26.7K
Cable	68.7K	75K	56K	45K	36K	59K	30K	0	0	0	0

TABLE 8: NITEL LTD. ROLL OUT PLANS

The second applicant for the Northern Ireland LDS franchise is CableComms. Although CableComms initially plans to deploy a wire-based network, it may utilize 41 GHz MVDS in its system, when available, to serve less populated areas within the franchise.

In contrast to the activity surrounding 41 GHz MVDS services, my understanding is that only Venezuela and Argentina have authorized LMDS in the 28 GHz band and licensed LMDS providers. Although Canada, Mexico and Brazil have authorized experimental LMDS-like systems at the 28 GHz band, these three countries have not reached a final decision on whether or not to allocate the 28 GHz band to LMDS-type services.

3. Conclusion

As demonstrated herein, the deployment of analogue and digital 41 GHz MVDS services at a reasonable cost is readily achievable. Additionally, use of the 41 GHz band for MVDS is consistent with the actions of numerous European countries, most notably the United Kingdom.

APPENDIX A

RADIOCOMMUNICATIONS AGENCY

40GWG(95)1
February 1995

40GHz MVDS WORKING GROUP

Notes of the second meeting of the 40GHz Working Group held on 15 December 1994 at 10.30 am in Room 403 Waterloo Bridge House.

Present:

Mr K Whittingham	(Chairman)	RA
Jacqui Bresnihan	(Secretary)	RA
Mr D Toman		RA
Mr A Harris		RA
Mr D Bush		RA
Mr K Dunk		RA
Mr J Connolly		RA
Mr D Hayter		RA
Mr R Carver		BT Laboratories
Mr P Hope		GEC Marconi Comms
Mr A Cox		Telecential Comms
Mr P Woodward		Eurobell
Mr P Marchant		National Trans Ltd
Mr F Ghasvinian		Teladesic Corp
Mr J Ettinger		Nynex Cable Coms
Mr T King		Mercury Communications
Mr L Davies		Cable & Wireless
Mr P Chalmers		ESV Ltd
Mr I Williamson		Silverstone Electronics
Mr M Hobden		GEC Plessey Semiconductors
Mr D Pearce		Marconi Electronics
Mr R Croll		OFTEL
Mr O'Connell		Off-Air Electronics
Mr G Heane		Flann Microwave Instruments
Mr I Clarke		Philips Research
Mr D Evans		Philips Microwave
Mr B Joshi		Scientific Generics
Mr T O'Connell		Scientific Generics
Mr D Harrison		Thomson Consumer Electronics
Mr R Preistal		
Mr D Sumner		Consultant
Mr P Gardiner		ITC
Mr A Mitchell		Cable Communications Assoc
Mr A Burke		Consultant
Mr D Cowan		CMTL
Mr T Phillips		Cable & Wireless Network
Mr G Sole		BNR Europe LTD

Apologies for absence were received from Mr Gibbins, Mr Aldous and Mr Parry.

I **Notes of the last meeting held 5 October 1994 - 40GWG(94)15**

1. The notes of the last meeting were approved without

APPENDIX B

Marconi
Electronics

The Grove, Warren Lane
Stanmore, Middx. HA7 4LY
England

Telephone: 0181-420 3857
Fax: 0181-420 3920

FACSIMILE

Ref:	40GHz MVDS System	
Date:	12th April 1995	Page 1 of 1
Attention:	Teddy O'Connell	
Company:	Scientific Generics	Fax No: 01223 424281
Copies:		
From:	Donald Pearce	

Teddy,

In reply to your query I can confirm that we are currently building a demonstration MVDS transmitter and receivers operating in the frequency band 40.5 to 42.5GHz. The transmitter is built to the UK specification MPT:550, which has been adopted by the UK and other EEC countries for analogue systems, with an additional digital capability based on the Astra plan, which uses QPSK modulation at 34Mbits per second, and a channel spacing of 39MHz.

The demonstrator will be available on site here from June 1995. Soon afterwards, depending on the level of demand, it will be made available for demonstrations offsite at customer installations. There is no reason in principle why this should not include the United States, provided that the FCC approves such a demonstration against the UK specification.

Regards,

Donald Pearce

APPENDIX C

Farran technology

TELEFAX

To: Teddy O'Connell Telefax No.: 00-44-223-424281	From: Brendan Lyons Farran Technology Ltd. Ballincollig Cork Ireland Tel: +353-21-872814 Fax: +353-21-873892

Date:	Reference No.:	No. of pages:	C.c.:
10th April'95	F14830/md	1 of 1	

RE: 40 GHz MVDS

Farran Technology have supplied and are currently supplying components for use in 40 GHz MVDS.

Regards,

Brendan Lyons

Brendan Lyons.

APPENDIX D

PHILIPS

FACSIMILE

Philips Electronics UK Ltd
The Philips Centre Croydon

Tel: (+44) 0181 781 8052
Fax: (+44) 0181 781 8186

To:	Teddy O'Connell Scientific Generics, Cambridge	Fax:	01223 424281
From:	Mike Stewart	Pages:	1
Date:	24 April 1995	Ref:	MDS.95/mm
Subject:	MVDS Demonstration Equipment		

Teddy

Thank you for your enquiry regarding the availability of demonstration equipment for our 42 GHz MVDS system.

Subject to agreeing dates etc, we could well be in a position to make equipment available to Scientific Generics. I would point out that my staff are fully committed for the remainder of this year to the next (digital) phase of our programme and I will not be able to release them to "man" the demonstration. It follows that we would need to train some of your people in its operation.

Beyond that, the equipment itself is relatively simple comprising a bank of VCRs, CD-i players or cameras (we use these rather than a "solo server"), a modulator bank and the transmitter outdoor unit. For demonstrations we have used an 8 channel (plus one hot stand-by) module rather than the full 32 (+4) channel transmitter defined by MPT 1550. At the receive end we have a receiving antenna plus down converter feeding a satellite set-top box.

This installation is currently in operation in Croydon under a temporary DTI licence.

As noted above, the demonstration equipment is in great demand, both internally (by my development staff) and for demonstrations to customers, and the key issue will be arranging a convenient release period. To this end can you please advise when and for how long you might need the equipment.

Regards

for Maureen [illegible]
Mike

APPENDIX E

Possible MVDS Channel Plans

Use of the proposed digital ASTRA channel plan, which has a 39 MHz co-polar channel spacing, allows a total of 100 channels to be accommodated in the 2 GHz of spectrum that is available for MVDS. This assumes interleaving of adjacent channels, each using alternate antenna polarisations. The centre frequencies that may be associated with each RF channel can be found in Annex 1.

From this selection of 100 channels, maximum flexibility with regard to channel grouping is achieved by only using 96. The spectrum occupied by the remaining 4 channels may be used for 40 GHz back channel return paths if these are required. It should be noted that different channel spacing may be employed in this area of spectrum compared to the rest of the MVDS allocation.

It is suggested that the best arrangements for return channels, if they are so employed, is to symmetrically place them at each extremity of the available spectrum. Using the channel numbering outlined in the annex, the spectrum occupied by channels 1, 2, 99 and 100 could be utilised for the return (subscriber to base station) paths. These two 50 MHz blocks are shown in Annex 2.

The frequency overlay scenario, where back channels are provided at a lower frequency, or even by some other means, has been suggested as the most appropriate for digital MVDS in the short to medium term. For future development however, it may be necessary to have a return channel contained within each channel group. The potential loading of the channel will dictate which type of system is used. The more use being made of return channels, the greater the number that will be required, and possibly the greater the bandwidth that needs to be allocated to each.

A 96 channel plan offers the following alternatives for the channel grouping:

4	groups of	24 RF channels
6		16
8		12
12		8
16		6
24		4

A selection of these channel groupings, believed to be the most useful, is illustrated in Annex 2. The nature of the interleaving employed in each of the channel plans is shown in Annex 3.

The number of RF channels made available for each group will need to be based on the number of programme channels that it is wished to supply. The data rate used for the transmission, which is itself related to the desired picture quality, will govern the ratio of programme channels to RF channels. However, there will be a frequency planning implication resulting from the final selection of number of channels per channel group that must not be ignored.

The more channel groups that are available, the less frequency re-use is required to cover any given franchise area. However, this is at the expense of having a reduced programming capacity, that is bandwidth, available per channel group. This scenario will be the easiest to manage from the frequency planning perspective. Co-channel stations will now have a greater separation, so achieving a reduction in the potential interference.

Conversely to this, the fewer the number of channel groups that are available, then the more difficult the frequency planning associated with the network. Re-use of any given single channel is now reaching a maximum, so giving a reduced geographical separation between the co-channel transmissions. There is now an increased number of programme services, that is bandwidth, available from each channel group. Applications such as video on demand will require large quantities of programme channels to be available since it effectively requires each of the receivers to have an individual link from the base station.

There is a further implication resulting from this scenario however. Every channel will be used more often. Consequently, the probability of a particular channel being in use at the boundary of the franchise area will also be increased. This could prevent use of that channel in part of the adjoining franchise area. Judicial planning considerations, such as the orientation of transmitting antennas, must be used so as to minimise the effect of transmission over-spill at franchise boundaries.

Having a 100% frequency re-use in adjacent cells would be the ideal frequency planning scenario. However, it is not realisable in practice because of the requirements for protection ratios of at least 15 - 20 dB, depending on the modulation and channel coding schemes used, between wanted and unwanted signals. Geographical and geometric separation will ultimately dictate this minimum re-use distance, taking into account the spectrum efficiencies that are gained by use of the 64° sector coverage of the horn antenna stipulated, and the 1° - 2° beamwidth of the receive antennas.

This distance is calculated using clear sky propagation and does not take into account periods of enhanced propagation. Events giving rise to these phenomena are not as yet quantified, although they are known to occur. Anomalous propagation will reduce protection margins planned into the development of a network. The desired availability of the service will also be a key factor in this planning.

As networks develop and grow, there is likely to be change in the needs of the service, resulting in a change of requirements for the channel groups. However, a total free for all in terms of channel grouping arrangements will be totally unmanageable from a frequency planning perspective. With different frequency groups in different franchise areas, transmission over-spill could preclude the use of only certain frequencies from within a group while others remain usable. This results in decreased spectral efficiency and extra complications in frequency planning. However, a degree of flexibility in channel groupings is desirable.

A compromise could therefore be to define two plans for the channel groups. This would offer the desired flexibility for future development of MVDS networks, while keeping the number of possibilities down to a much more realistic level.

In considering the choice of channel groups, the question of local oscillator frequencies also arises. The previous thinking in the 40 GHz Working Group, and as espoused in MPT1550, was that the receiver local oscillator would be constrained within the 40 GHz band. This would ensure that any emissions would affect the MVDS service before others. Two local oscillator frequencies were defined with one at the top and one at the bottom of the band; the particular frequency to be used is then selected for the channel group being received. This produces a range of intermediate frequencies tunable within the standard IRD tuning range of 950 to 1950 MHz.

It has been suggested that an alternative to the in-band local oscillator would be to use a double conversion process whereby the first local oscillator frequency is placed at around 29 to 31 GHz producing a first IF within the tuning range of a "standard" 11/12 GHz LNB mixer / downconvertor. This architecture is appealing in that existing, possibly lower cost, 29 GHz oscillator technology can be employed with low cost mass produced LNBs. There is also the advantage that the local oscillator frequency would be below waveguide cutoff frequency therefore local oscillator emission problems would be eliminated. Examples of how the single and double conversion receiver frequency plans could be implemented for digital MVDS using the proposed frequency plan are given in Annex 4.

Television Broadcasting Section
Radiocommunications Agency

20 April 1995

Annex 1

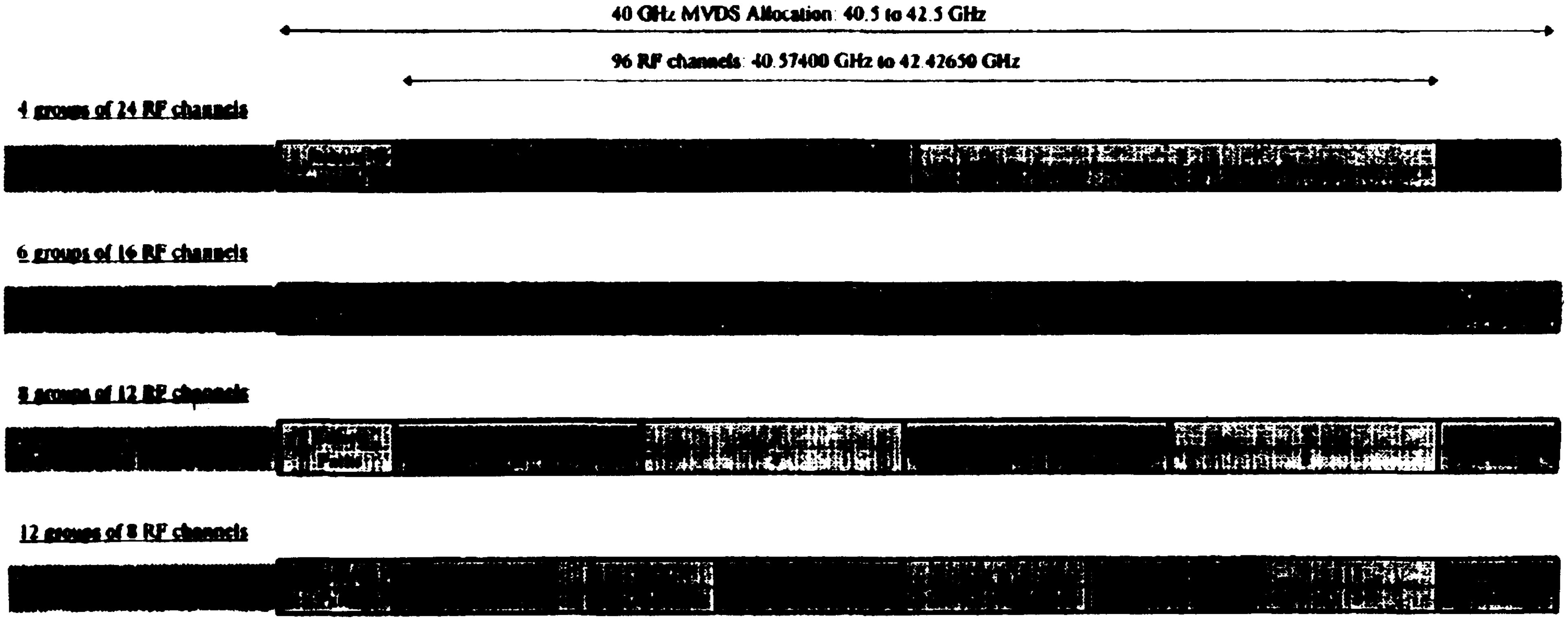
Channel Plan for 40 GHz Digital MVDS Systems

Channel Number	Centre Frequency	Channel Number	Centre Frequency
1	40.53500	2	40.55450
3	40.57400	4	40.59350
5	40.61300	6	40.63250
7	40.65200	8	40.67150
9	40.69100	10	40.71050
11	40.73000	12	40.74950
13	40.76900	14	40.78850
15	40.80800	16	40.82750
17	40.84700	18	40.86650
19	40.88600	20	40.90550
21	40.92500	22	40.94450
23	40.96400	24	40.98350
25	41.00300	26	41.02250
27	41.04200	28	41.06150
29	41.08100	30	41.10050
31	41.12000	32	41.13950
33	41.15900	34	41.17850
35	41.19800	36	41.21750
37	41.23700	38	41.25650
39	41.27600	40	41.29550
41	41.31500	42	41.33450
43	41.35400	44	41.37350
45	41.39300	46	41.41250
47	41.43200	48	41.45150
49	41.47100	50	41.49050
51	41.51000	52	41.52950
53	41.54900	54	41.56850
55	41.58800	56	41.60750
57	41.62700	58	41.64650
59	41.66600	60	41.68550
61	41.70500	62	41.72450
63	41.74400	64	41.76350
65	41.78300	66	41.80250
67	41.82200	68	41.84150
69	41.86100	70	41.88050
71	41.90000	72	41.91950
73	41.93900	74	41.95850
75	41.97800	76	41.99750
77	42.01700	78	42.03650
79	42.05600	80	42.07550
81	42.09500	82	42.11450
83	42.13400	84	42.15350
85	42.17300	86	42.19250
87	42.21200	88	42.23150
89	42.25100	90	42.27050
91	42.29000	92	42.30950
93	42.32900	94	42.34850
95	42.36800	96	42.38750
97	42.40700	98	42.42650
99	42.44600	100	42.46550

Note: Even numbered channels are Horizontally polarised.
Odd numbered channels are Vertically polarised.

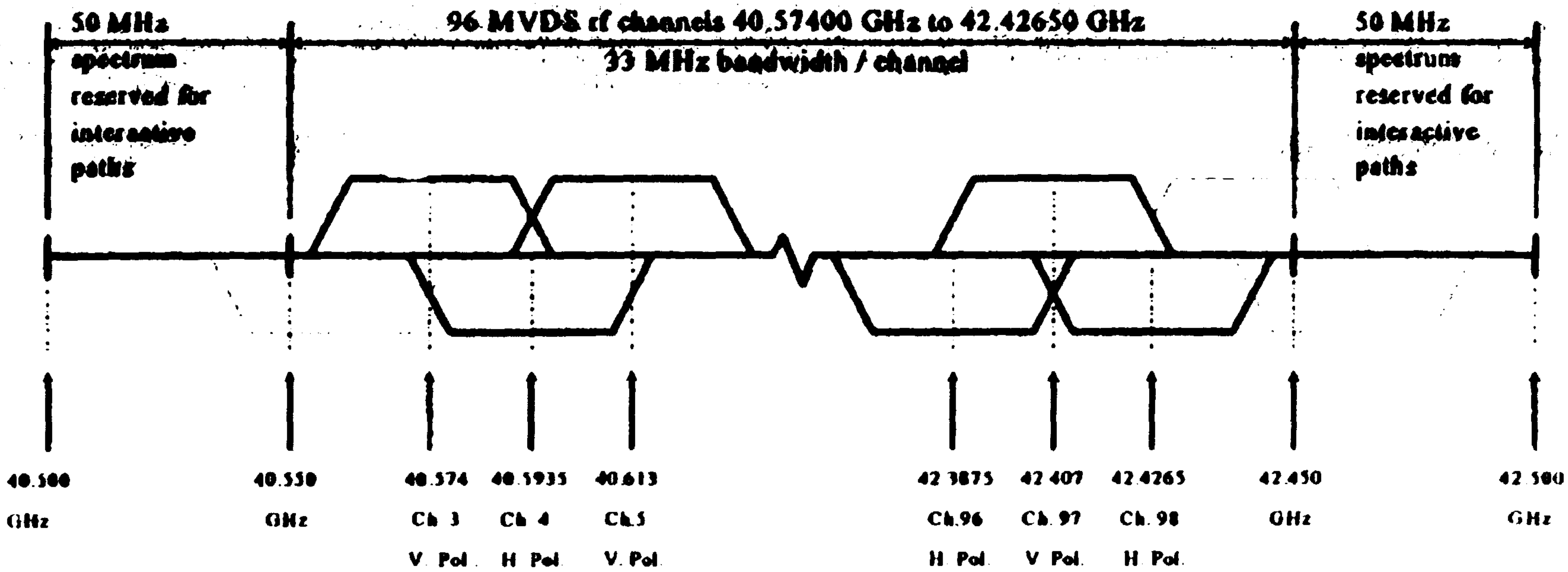
Annex 2

Examples of Possible MVDS Channel Plans



Annex 3

Channel Interleaving and Spectrum Reserved for Interactive Back channels



Annex 4 **Receiver Local Oscillator Frequencies - Four Channel Group Plan**

Channel Group 1 (V.Pol)	Ch.3 to Ch.49	40.5740 to 41.4710 GHz
Channel Group 2 (H.Pol)	Ch.4 to Ch.50	40.5935 to 41.4905 GHz
Channel Group 3 (V.Pol)	Ch.51 to Ch.97	41.5100 to 42.4070 GHz
Channel Group 4 (H.Pol)	Ch.52 to Ch.98	41.5295 to 42.4265 GHz

Nominal IF range of digital IRD - 950 MHz to 1950 MHz

Single Conversion

Channel Groups 1 & 2 - Local Oscillator 42.4605 GHz

1st Intermediate Frequency Range	Group 1	989.5 to 1886.5 MHz
	Group 2	970.0 to 1867.0 MHz

Channel Groups 3 & 4 - Local Oscillator 40.5400 GHz

1st Intermediate Frequency Range	Group 3	970.0 to 1867.0 MHz
	Group 4	989.5 to 1886.5 MHz

Double Conversion

Utilising standard digital satellite LNB as 2nd mixer / downconvertor:
FSS LNB input range 10.7 to 11.7 GHz
BSS LNB input range 11.7 to 12.7 GHz

1st Local Oscillator Frequencies

Using FSS LNB:	Groups 1 & 2 29.814 GHz	Groups 3 & 4 30.750 GHz
Using BSS LNB:	Groups 1 & 2 28.814 GHz	Groups 3 & 4 29.750 GHz

1st Intermediate Frequency Range	Group 1	10.7600 to 11.6570 GHz
Using FSS LNB	Group 2	10.7795 to 11.6765 GHz
	Group 3	10.7600 to 11.6570 GHz
	Group 4	10.7795 to 11.6765 GHz

1st Intermediate Frequency Range	Group 1	11.7600 to 12.6570 GHz
Using BSS LNB	Group 2	11.7795 to 12.6765 GHz
	Group 3	11.7600 to 12.6570 GHz
	Group 4	11.7795 to 12.6765 GHz

2nd Local Oscillator Frequencies

FSS LNB 9.75 GHz
BSS LNB 10.75 GHz

2nd Intermediate Frequency Range	Groups 1 & 3	1010.0 to 1907.0 MHz
	Groups 2 & 4	1029.5 to 1926.5 MHz

APPENDIX F